AN3280
Application Note

Displaying variable voltage on a bar of LEDs using STM8S-DISCOVERY

Application overview

This application note provides a short description of how to use the ADC, Timer and GPIO peripherals.

Once the STM8S105C6T6 has been powered-up through a USB cable connected to the host PC, the Timer triggers the ADC according to a user-defined period to convert the analog voltage provided by variable resistor RV1. The resulting average voltage measurement is represented on the LED bar.

Even though the STM8S-DISCOVERY is built around an STM8S105C6T6, it allows evaluation of the main features of all the STM8S MCUs.

Reference documents

- STM8S-DISCOVERY evaluation board user manual (UM0817).
- Developing and debugging your STM8S-DISCOVERY application code user manual (UM0834).

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1 Application description

1.1 Hardware requirements

No on-board resources are used.

External resources needed are:

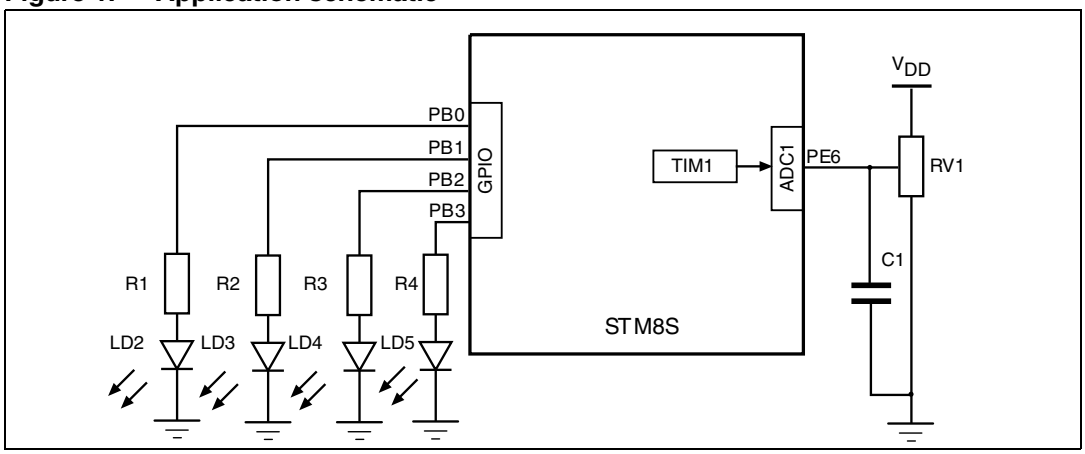
- 4 LEDs: LD2, LD3, LD4, LD5
- 1 x 10 KΩ variable resistor: RV1
- 4 x 1 KΩ resistors: R1, R2, R3, R4
- 1 x 100 nF capacitor: C1

1.2 Application schematic

Capacitor C1 filters the voltage spike on PE6.

Resistors R1, R2, R3 and R4 limit the current going into LD2, LD3, LD4 and LD5 respectively.

Figure 1. Application schematic



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1.3 Application principle

This application uses the ADC1, TIM1 and GPIO peripherals.

The input voltage analog signal from variable resistor RV1 is sampled and filtered on channel 9 of the ADC1 system (PE6), which is internally triggered by TIM1.

The average value of this signal is represented on the LED bar (LD2-5).

Table 1. Voltage and LED correspondence

Voltage (V)	LEDs switched on
0.0 - 0.7	None
0.7 - 2.0	LD2
2 - 3	LD2 + LD3
3 - 4	LD2 + LD3 + LD4
4 - 5	LD2 + LD3 + LD4 + LD5

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2 Software description

This application uses neither the STM8S standard library nor the STM8 touch sensing library. The peripherals used in this application are:

- **ADC1:** Voltage acquisition. Must be configured as:
  - Single conversion mode
  - External trigger by TIM1 TRGO
  - ADC_clock = Fmaster/8
  - Left alignment result (otherwise a software modification is required to calculate the average)
  - Disable Schmitt trigger on ADC1 input 9: for analog input
- **TIM1:** Timer TIM1 has two aims in this application:
  - To wake up the ADC for incoming conversion when the counter value reaches CCR1 (Capture/compare interrupt). This action is very useful to allow ADC stabilization time before the conversion.
  - To send a conversion trigger signal to launch the ADC conversion when the counter value reaches TIM1_ARR.

  With these two events you can easily manage ADC wake-up and conversion timing. For this use, TIM1 must be configured with:
  - Compare-OC1REF trigger output
  - PWM1 mode on PC1 (negative polarity): for testing purpose (to measure exactly the time allowed for stabilization)
- **GPIO:** Configures PB0, PB1, PB2 and PB3 in output push/pull mode to control LEDs LD2, LD3, LD4 and LD5.

Figure 2 illustrates ADC1 acquisition principle.

1. TIM1 is configured as an upcounting counter.
2. When the compare/capture interrupt occurs, the ADC1 is woken up for the incoming conversion (the stabilization time of the ADC1 is respected before the ADC conversion).
3. On TIM1 TRGO, the ADC1 starts the conversion.
4. When the conversion is finished, the result is stored in RAM and the ADC1 is powered down until the next compare/capture interrupt.
5. When 8 conversion results have been stored, the main routine calculates the average of these results and displays it on the LED bar.

Note: OC1REF complementary signal is forced out on CC1 output pin (PC1) for test purposes.

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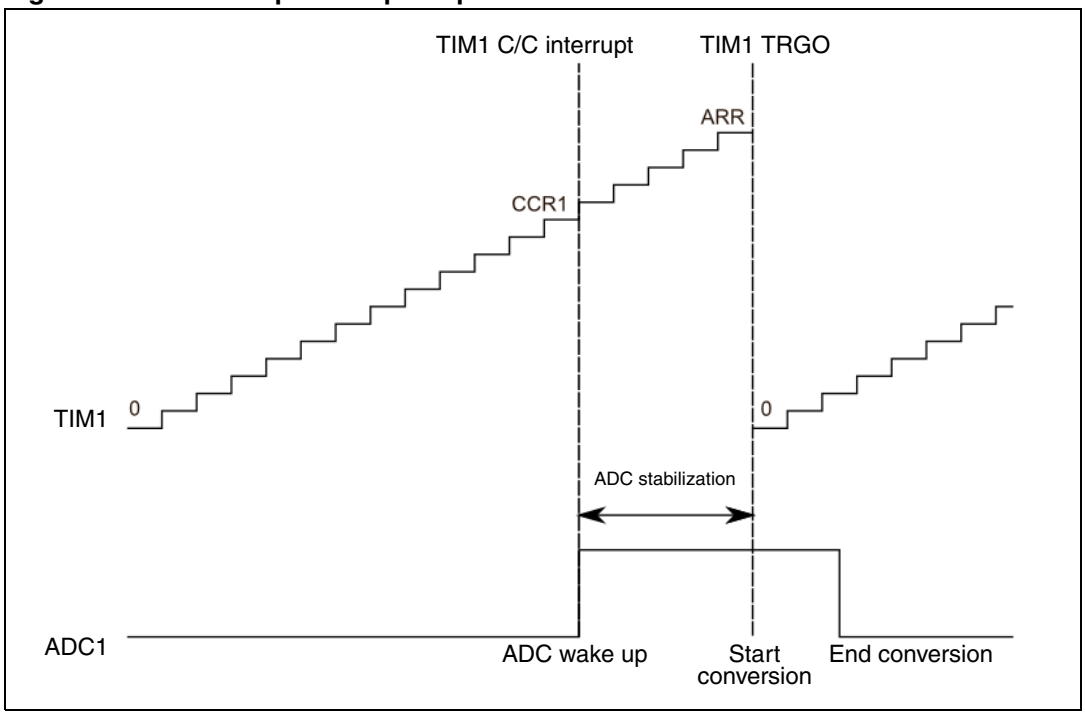
Figure 2. ADC1 acquisition principle



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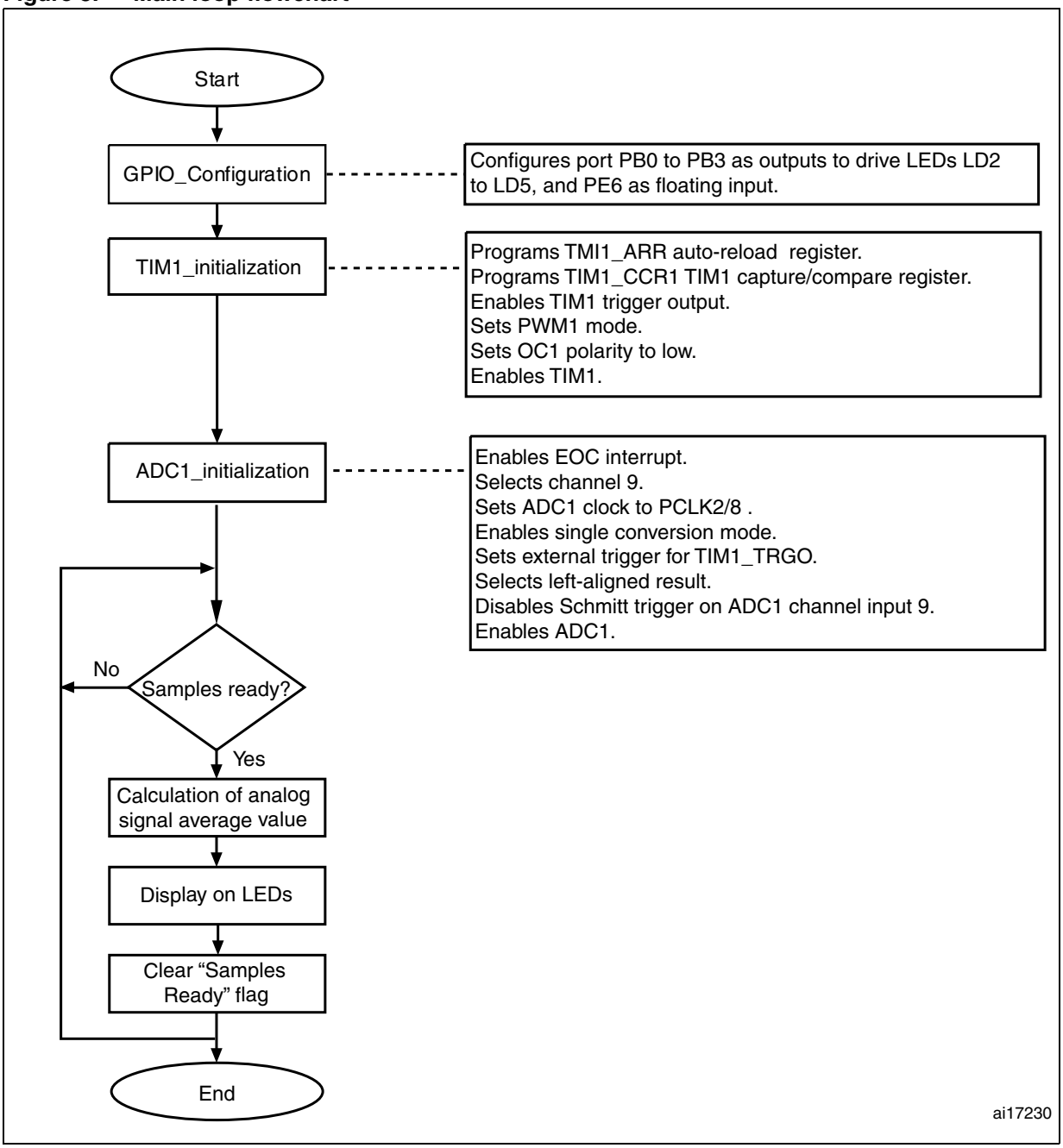
2.1 Application software flowcharts

2.1.1 Main loop flowchart

Figure 3. Main loop flowchart



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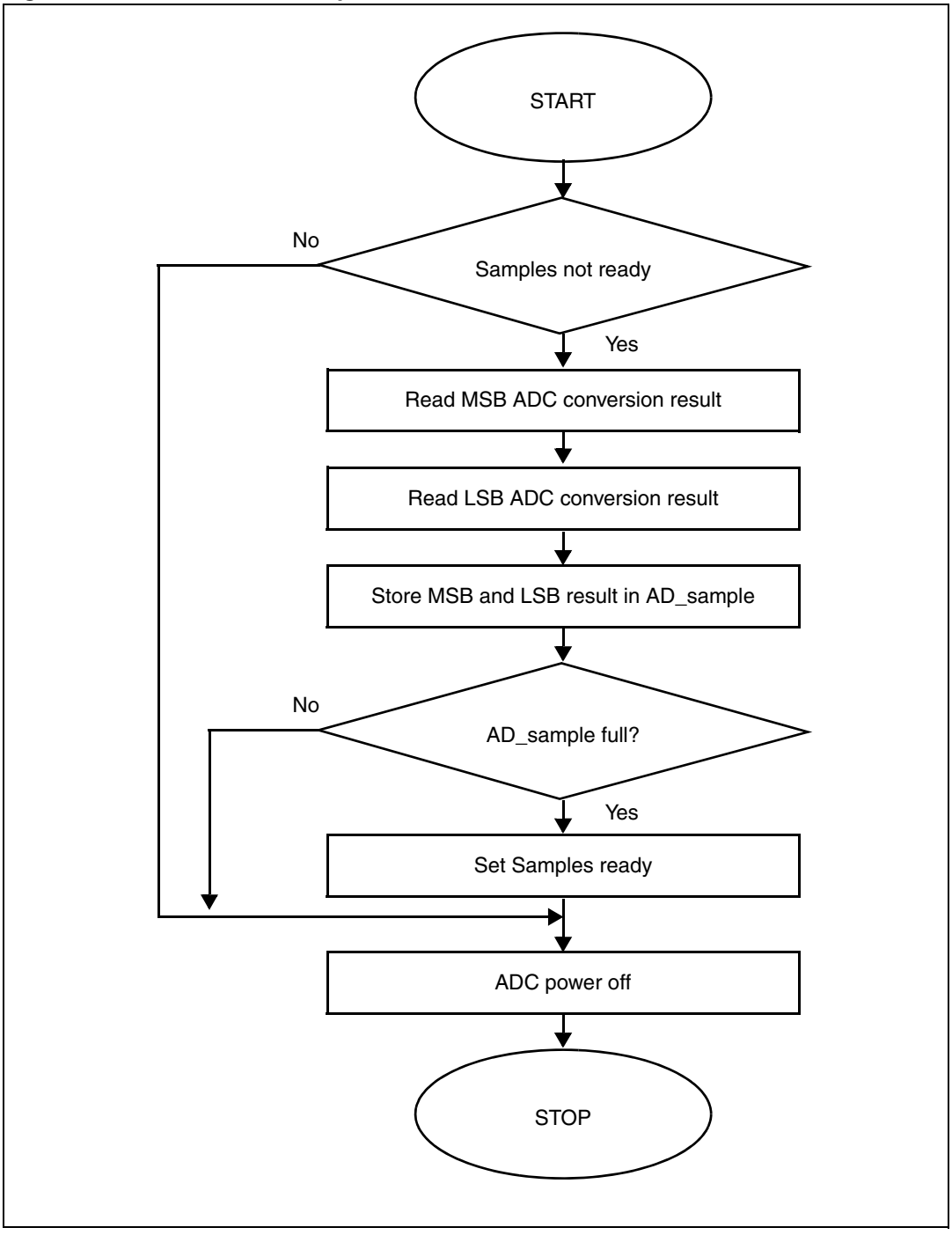
2.1.2 ADC1 interrupt routine

This interrupt occurs when the ADC1 has finished an analog to digital conversion. Every time it occurs the conversion result is stored in a table called AD. When this table is full the variable `ADSampRdy` is set to 1 and the AD table is treated by the main routine (it calculates the average of the stored values). The ADC is switched off at the end of the interrupt routine.

Note: The result is stored only if the previous AD table has been treated by the main routine.

Figure 4. ADC1 EOC interrupt flowchart



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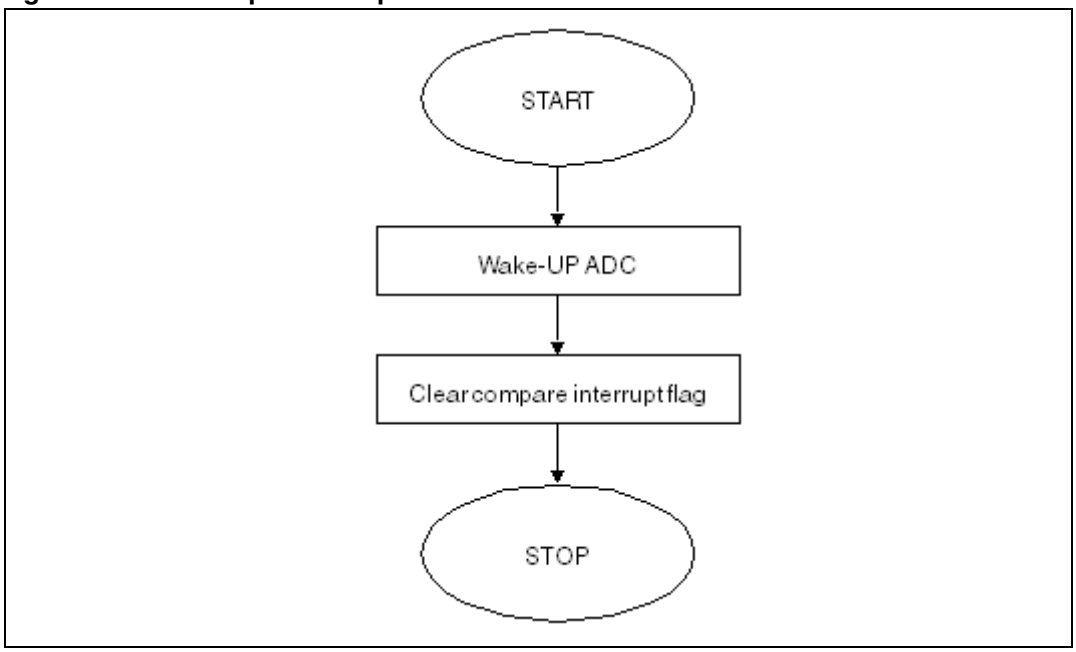
2.1.3 TIM1 capture/compare interrupt

This interrupt occurs each time the TIM1 counter value is equal to the Compare register value CCR1. During this interrupt process, conversion is triggered by setting the ADON bit of the CR1 register.

Figure 5. TIM1 capture/compare flowchart



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3 Revision history

Table 2. Document revision history

Date	Revision	Changes
21-Oct-2010	1	Initial release. UM0848 has been converted into this Application note. This document replaces UM0848.

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